PRELIMINARY RESULTS OF SPECTRAL REFELECTANCE STUDIES OF TYCHO CRATER

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INTRODUCTION

Spectral studies of lunar craters and their ejecta deposits provide valuable information about the composition of the lunar crust as well as insights into the impact cratering process. Materials from a variety of depths have been excavated by these impacts and deposited in a systematic manner around the craters. Hence, information concerning vertical and lateral changes in the composition of the lunar crust can often be obtained by careful analysis of spectral data of these ejecta deposits. Results of multispectral imaging studies of Tycho, Aristilus, Lalande, and Kepler were published by Hawke *et al.* (1979).[1] Lucey *et al.* (1986)[2] more recently have published the results of a spectral reflectance study of Aristarchus crater and its deposits. This paper presents the preliminary analysis and interpretation of near-infrared spectra obtained for both the interior and exterior deposits associated with Tycho crater. Specifically, our objectives were: 1) to determine the composition and stratigraphy of the highland crust in the Tycho target site, 2) to determine the likely composition of the Tycho primary ejecta which may be present in ray deposits, 3) to investigate the nature of spectral units defined in previous studies, 4) to further investigate the nature and origin of both the bright and dark haloes around the rim crest, and 5) to compare the compositions determined for the various Tycho units with those of Aristarchus crater as well as "typical" highlands deposits.

METHOD

Near infra-red spectra (0.6 - 2.5 μm)for small (~2 km) areas in and around Tycho were obtained at the Mauna Kea 2.24-m telescope using the Planetary Geosciences Division indium antimonide spectrometer. Extinction corrections were made using the techniques described by McCord and Clark (1979).[3] Analyses of absorption bands and continuum slopes were made using the

methods presented by McCord *et al.* (1981).[4] Spectra were collected for the following areas: 1) the southwest crater wall, 2) the northern rim, 3) the southwest floor, 4) the eastern floor, 5) the central peak, 6) the northeast ejecta blanket, and 7) the dark halo north of the crater. The residual absorption spectra (after continuum removal) are shown in Figure 1.

RESULTS AND DISCUSSION

The spectra obtained for areas on the interior of Tycho exhibit similar spectral features. These include relatively strong 1μm absorption bands whose minima are centered between 0.97 and 0.99 μm and shallow to intermediate continuum slopes. The spectra generally exhibit indications of a 1.3 μm feature consistent with the presence of Fe^{2+}-bearing plagioclase feldspar. The strong 1 μm absorption features indicate a dominant high-Ca clinopyroxene component. These spectra are all Type G as defined by Pieters (1986).[5] The material exposed on the interior of Tycho is a gabbroic assemblage with compositions ranging between gabbro and anorthositic gabbro.

The spectrum that we obtained for the Tycho central peak is slightly different from that presented by Smrekar and Pieters (1986).[6] Their spectrum exhibits a shallower continuum slope, a deeper 1 μm band centered at a slightly longer wavelength (0.99 μm vs. 0.98 μm), and a well-defined 1.3 μm absorption feature. Their spectrum was collected for a larger area of the Tycho central peak and may better represent the character of peak as a whole than does the one we present in Figure 1.

Spectra were also obtained for Tycho ejecta deposits. Hawke *et al.* (1979)[1], noted that the Tycho rim crest is surrounded by two spectrally distinct haloes. The inner, bright halo is narrow, discontinuous, and poorly developed south of the crater. The outer, dark halo is more extensive and continuous and extends in places to almost one crater diameter from the rim crest. One spectrum was collected for an area just north of the Tycho rim crest. This area appears to be typical of the inner, bright halo. The spectrum is almost identical to those obtained for interior units and a similar composition is implied.

The spectrum obtained for a portion of the dark halo north of Tycho is very different from those of the interior units. This spectrum exhibits a wide, relatively shallow absorption feature centered at 1.01 μm, a 1.3 μm absorption, and a relatively steep continuum slope. This spectrum is very similar to that

presented by Smrekar and Pieters (1986)[6] for a portion of the dark halo southwest of Tycho. They interpreted their spectrum as indicating the presence of pyroxene, Fe-bearing feldspar, and a significant component of Fe-bearing impact melt glass. We agree with this interpretation and suggest that the dark halo north of the crater is composed of a similar assemblage.

The spectra of spots inside of Tycho show, in the context of the highlands thus far investigated, the greatest similarity to certain spectra obtained for features in the Aristarchus region (i.e., Class 1) of Lucey *et al.* (1986).[2] However, the suite of spectra obtained for Tycho exhibits a different trend than that of the Aristarchus spectra in terms of band center versus width. Aristarchus spectra show a strong correlation between band center and width which Lucey *et al.* (1986)[2] attributed to a variation in olivine content in the highland units in the region. This is not the case at Tycho. Apparently, olivine is absent or present in only minor amounts in the Tycho region.

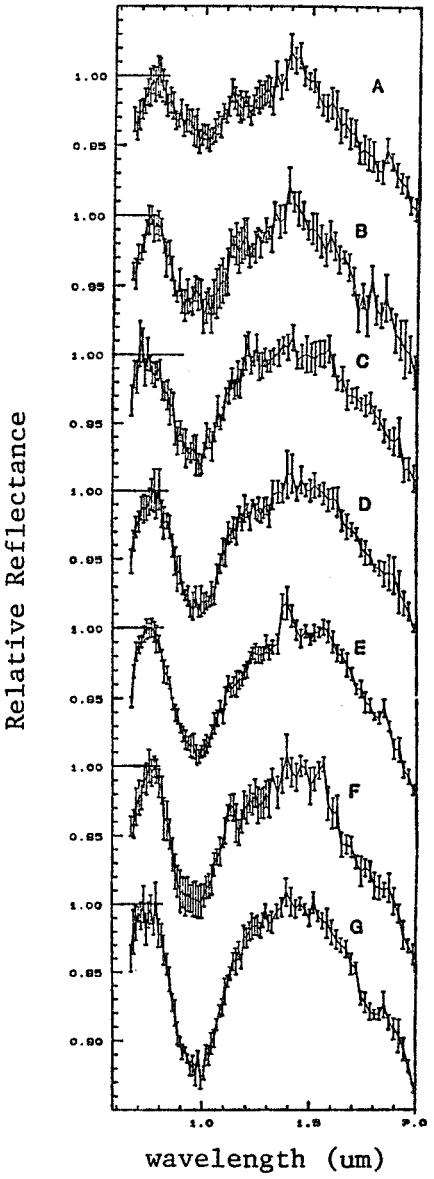

FIGURE 1:
Spectra of locations of Tycho crater interior and exterior deposits, with straight line continua removed. (A) Dark halo, north (B) Northeast ejecta (C) Southwest wall (D) Southwest floor (E) East floor (F) North rim (G) Tycho central peak.

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